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The Effects of A Cognitive Training Program for Older Adults: A Brief Preliminary Report

Nathan Jensen, Caroline Kinskey, and Jeffrey Buchanan

Minnesota State University – Mankato

ABSTRACT

As one ages, some degree of cognitive decline is expected. Despite this, declines in cognitive abilities and the possibility of dementia is a common concern among older adults. In response to these concerns, a variety of cognitive training programs have been developed that aim to improve or maintain cognitive functioning. Prior literature has shown mixed or limited findings on cognitive changes after implementation of cognitive training. This study evaluated the effectiveness of a cognitive training program designed for older adults with no to minimal cognitive decline. The current study included 17 participants who engaged in two one-hour cognitive training sessions each week for 12 weeks. Each session required participants to complete activities that targeted the following cognitive domains: attention, visual and verbal memory, visual spatial skills, processing speed and executive functioning, and language. These cognitive domains, along with depression and memory self-efficacy, were assessed prior to and immediately after completion of the program. Small to large effect sizes on the majority of cognitive outcome measures were observed following participation in the program. Small reductions in depressive symptoms were also found. These findings provide preliminary support for the use of a comprehensive cognitive training program for cognitively-intact older adults.

Keywords: aging, older adults, cognitive interventions, cognitive assessment, cognitive training

*Correspondence to Author:

Jeffrey Buchanan, Ph.D.

Department of Psychology, 103
Armstrong Hall, Mankato, MN, USA
56001.

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As adults age, many begin to notice declines in cognitive abilities and report things such as, “I’m not as sharp as I used to be.” In fact, as people age, they tend to experience “age-associated cognitive decline” (Deary et al., 2009). Skills that typically slow or decline with age include: processing speed and reaction time, divided and sustained attention, various memory abilities (e.g., working, episodic memory), verbal fluency, confrontation naming, visual construction, cognitive flexibility, and response inhibition (Harada, Natelson-Love, & Triebel, 2013; Salthouse, 2012). The severity of deterioration and the degree of negative impact on functioning varies greatly across individuals (Deary et al., 2009; Salthouse, 2012). For instance, negative effects may include periodic embarrassment, frustration, or emotional distress. More significantly, subjective complaints of cognitive decline are associated with greater depressive symptoms and may lead to concerns about the possibility of developing dementia (Minett, Da Silva, Ortiz, & Bertolucci, 2007).

In response to concerns about cognitive decline and dementia, cognitive training programs have been created with the goal of improving or maintaining cognitive abilities. “Cognitive training” refers to interventions that use guided practice on a set of standardized tasks that target specific cognitive functions (Bahar-Fuchs, Clare, & Woods, 2013). Cognitive training typically takes place in small groups and is comprised of a standardized, structured program of activities (Belleville, 2008). The goal of cognitive training is to improve cognitive functioning, sustain functioning, or slow cognitive decline. The assumption underlying cognitive training is that the brain remains plastic as people age, so practicing cognitive activities will improve or maintain functioning (Hertzog, Kramer, Wilson, & Lindenberger, 2008).

Many “brain game” products on the market claim to improve cognitive abilities, but many exaggerate the positive effects of their programs and can mislead consumers (Simons et al., 2016). Conversely, recent reviews of the

empirical literature conclude that cognitive training may result in some circumscribed benefits. Gross and associates (2012) examined studies targeting memory functioning in community-dwelling, cognitively-intact older adults. The authors found that memory training interventions resulted in improvements larger than retest effects in control groups and that training participants in multiple memory strategies produced larger gains. Simons and colleagues (2016) also reviewed the “brain training” literature and found evidence for improvements on trained tasks, but little evidence of benefits on related cognitive tasks or everyday cognitive functioning.

Purpose of Current Study

The current study collected preliminary data regarding the effectiveness of a cognitive training program that was implemented in an independent living facility for retired nuns. Based on prior research, improvements on measures of executive functioning, processing speed, and verbal and visual memory were hypothesized to occur (Ball et al., 2002; Gross et al., 2012). Analyses concerning attention, visuospatial skills, and language were exploratory in nature given that few studies have examined the impact of cognitive training on these abilities. In addition, it was hypothesized that participants would report improvements in memory self-efficacy because of expectations about the benefits of cognitive training. Finally, participating in cognitive training represents an attempt to mitigate worries about declines in cognitive functioning, so it was hypothesized that participants would report fewer depressive symptoms after the program.

Method

Participants

Participants were recruited from a facility serving retired nuns located in a small Midwestern metropolitan area in the United States. To be included in the study, participants were required to achieve a score of 78 or above on the Modified Mini-Mental Status Examination (3MS;

Teng & Chui, 1987), which is the “intact/mild” range. 3MS scores ranged from 81-97 ($M = 92.2$, $SD = 4.63$). Exclusion criteria included a 3MS score below 78 or the presence of significant visual, hearing, or motor impairments that could prevent successful participation in the program. The presence or absence of a neurocognitive disorder, however, was not an exclusion criterion because staff reported that some individuals were a good fit for the program and met all inclusion criteria despite having a diagnosis of neurocognitive disorder. Likewise, staff observed other individuals who were experiencing cognitive decline, but did not have a diagnosis of neurocognitive disorder. Therefore, diagnostic status appeared to be an imperfect indicator of the severity of cognitive impairment and appropriateness for the program.

A convenience sample of 18 individuals participated, although one participant dropped out prior to completing the program. All other participants completed at least 75% of the classes (range = 79-100%, $M = 94.4\%$). All participants were Caucasian women that had at least a bachelor’s degree. Ages ranged from 71-93 years old ($M = 82.82$, $SD = 7.30$). Five individuals carried a diagnosis of a condition that affects cognitive functioning (e.g., dementia), with two of these individuals taking medication for dementia. In addition, seven participants carried a diagnosis of major depressive disorder, with five taking antidepressant medication and one taking an anxiolytic. The dosages of all medications remained unchanged throughout the study.

Table 1 Outcome Measures

Cognitive Domain	Instrument
Global Cognitive Ability	Modified Mini-Mental State Examination (3MS; Teng & Chui, 1987)
Attention	Forward & Backward Digit Span (Wechsler, 2008) Brief Test of Attention (Schretlen, 1997)
Visual Memory	Brief Visuospatial Memory Test – Revised (Benedict, 1996)
Verbal Memory	Hopkins Verbal Learning Test (Brandt & Benedict, 2001)
Visual Spatial Skills	Visual Puzzles (Wechsler, 2008)
Processing Speed & Executive Functioning	Trail Making Test Part A & B (Reitan & Davidson, 1974)
Language	Controlled Oral Word Association Test (Benton & Hamsher, 1989) Boston Naming (Kaplan, Goodglass, & Weintraub, 1983)
Depression	Patient Health Questionnaire-9 Observer Version (Kroenke, Spitzer, & Williams, 2002)
Memory Self-efficacy	Cognitive Failures Questionnaire (Broadbent, Cooper, FitzGerald & Parkes, 1982)

Materials

The cognitive training program used in this study was created by the New England Cognitive Center (NECC) and was called *Mind Sharpener*. The program is designed for adults with no or very mild cognitive decline and who

report subjective cognitive decline that does not interfere with completing daily activities.

Prior to the start of the study, a master trainer from the NECC trained staff to deliver the *Mind Sharpener* program. A manual that included detailed instructions about how to deliver the

program was also provided. The program included 24, one-hour classes delivered twice a week over a twelve-week period. Two separate classes were delivered in a group format, with both groups initially including nine participants. Each class included a sequence of paper-and-pencil activities related

to six cognitive domains: processing speed, attention, visuospatial skills, short-term memory, language, and problem solving. Activities within each domain took approximately 5-12 minutes and gradually increased in difficulty as the program progressed.

Table 2 Results of Paired-Sample t-test for Cognitive and Non-Cognitive Measures

Measure	Pre		Post		t	df	Sig. (2-tailed)
	M	SD	M	SD			
Global Cognitive Ability (3MS)	92.24	4.63	94.00	5.65	1.31	16	.209
Simple Attention (Forward Digit Span)	8.71	1.69	8.88	2.15	.447	16	.661
Working Memory (Backward Digit Span)	8.18	2.19	8.71	1.96	1.21	16	.245
Divided Attention (BTA)	5.76	2.51	6.94	2.41	2.14	16	.048*
Processing Speed/Executive Functioning (Trails A)	50.35	20.85	43.94	16.07	-1.60	16	.130
Processing Speed/Executive Functioning (Trails B)	126.94	46.46	114.88	47.71	-1.59	16	.131
Immediate Verbal Recall (HVLT)	19.41	4.23	23.18	4.68	4.25	16	.001***
Delayed Verbal Recall (HVLT)	6.29	2.69	8.12	2.29	2.67	16	0.017*
Verbal Recognition (HVLT)	9.47	1.38	10.29	1.49	3.57	16	0.003**
Immediate Visual Recall (BVM-T-R)	14.47	7.72	16.06	7.55	1.54	16	.142
Delayed Visual Recall (BVM-T-R)	5.82	3.43	6.59	3.55	1.42	16	.175
Visual Recognition (BVM-T-R)	5.00	1.37	5.29	1.31	1.16	16	.264
Language/Executive Functioning (COWAT)	27.12	7.73	26.35	11.10	-0.39	16	.703
Language (Boston Naming)	24.88	2.74	25.00	2.98	0.20	16	.847
Visual-Spatial (Visual Puzzles)	10.71	2.52	11.41	2.69	0.97	16	.346
Depression (PHQ-9)	5.47	4.30	4.59	4.47	-1.07	16	.302
Perception of Memory (CFQ)	34.94	13.10	34.00	12.36	-0.36	16	.720

*p<.05; **p<.01; ***p<.001

Experimental Design and Procedure

Because this was a pilot study designed to assess the potential benefits of the program, a pre-post quasi-experimental design was

employed. After signing a consent form (approved by the Institutional Review Board), the researchers administered a battery of neuropsychological tests to assess the six cognitive domains targeted by the program one

week prior to starting the program and within one week following the completion of the program. In addition, participants completed measures of memory self-efficacy and mood (Table 1 lists all outcome measures).

Results

A paired-samples t-test was conducted to determine the effects of the program on

cognitive functioning, depressive mood, and memory self-efficacy. There was a statistically significant difference in the scores for divided attention, $t(16) = 2.14, p = .048$; immediate verbal recall, $t(16) = 4.25, p = .001$; delayed verbal recall, $t(16) = 2.67, p = .017$; and verbal recognition, $t(16) = 3.57, p = .003$ (see Table 2).

Table 3 Effect Size Results for Cognitive and Non-Cognitive Measures

Measure	95% Confidence Interval		Cohen's d	Interpretation
	Lower	Upper		
Global Cognitive Ability (3MS)	-0.322	1.033	0.36	Small Effect
Simple Attention (Forward Digit Span)	-0.576	0.769	0.12	No Effect
Working Memory (Backward Digit Span)	-0.396	0.956	0.28	Small Effect
Divided Attention (BTA)	-0.174	1.192	0.51	Moderate Effect
Processing Speed/Executive Functioning (Trails A)	-1.033	0.323	-0.36	Small Effect
Processing Speed/Executive Functioning (Trails B)	-1.07	0.287	-0.39	Small Effect
Immediate Verbal Recall (HVLTL)	0.375	1.817	1.10	Large Effect
Delayed Verbal Recall (HVLTL)	-0.081	1.294	0.61	Moderate Effect
Verbal Recognition (HVLTL)	0.199	1.611	0.93	Large Effect
Immediate Visual Recall (BVMT-R)	-0.307	1.049	0.37	Small Effect
Delayed Visual Recall (BVMT-R)	-0.325	1.03	0.35	Small Effect
Visual Recognition (BVMT-R)	-0.404	0.947	0.27	Small Effect
Language/Executive Functioning (COWAT)	-0.798	0.548	-0.13	No Effect
Language (Boston Naming)	-0.621	0.723	0.05	No Effect
Visual-Spatial (Visual Puzzles)	-0.433	0.917	0.24	Small Effect
Depression (PHQ-9)	-0.939	0.412	-0.26	Small Effect
Perception of Memory (CFQ)	-0.758	0.587	-0.09	No Effect

In order to estimate the clinical magnitude of the differences between pre- and post-intervention measures, effect sizes (Cohen's d) for each independent variable were calculated (see Table 3). Large effect sizes (> 0.80) were found for the following cognitive domains: immediate verbal

recall and verbal recognition. Moderate effect sizes (0.50-0.80) were found for the following cognitive domains: divided attention and delayed verbal recall. Small effect sizes (0.20-0.49) were found for the following cognitive domains: working memory, processing speed

and executive functioning, immediate and delayed visual recall, visual recognition, and visual-spatial skills. Finally, no meaningful effect sizes (<0.20) were found for the following cognitive domains: simple attention and both language measures. In addition, there was a small effect size on the measure of depression, but none for memory self-efficacy.

Discussion

Results indicated modest improvements on the majority of measures of cognitive functioning. Several findings were consistent with previous research. For example, similar to previous studies, measures of processing speed and executive functioning showed small improvements (Ball et al., 2002). In addition, improvements on measures of immediate verbal recall, verbal recognition, and delayed verbal recall are consistent with previous research (Ball et al., 2002; Gross et al., 2012). The positive findings regarding verbal memory may be due to the relatively high “dose” of verbal memory exercises in the program (approximately 25% of class content). Similarly, measures of visual recall, visual recognition, and delayed visual recall all showed a small improvement, a finding consistent with prior literature on the impact of cognitive training on visual and general memory functioning (Ball et al., 2002; Gross et al., 2012). Exploratory analyses revealed small to moderate improvements in attention and visuospatial skills. These results could be related to the content of the cognitive training classes. For example, the attention exercises in the program involved tasks similar to what is required for the Brief Test of Attention (e.g., presenting target and distractor stimuli and asking participants to report the number of target stimuli detected). In addition, classes included a variety of visuospatial tasks that require mental rotation or reversal of visual stimuli, skills assessed by the Visual Puzzles test.

Language was the only cognitive domain that did not show improvement. One explanation for this finding is that “language” is a very broad construct that consists of a variety of abilities.

Therefore, the instruments used to measure language abilities may not have accurately assessed the specific language skills targeted by the classes. Furthermore, given that the program includes a number of different language exercises, relatively little practice is devoted to specific skills measured in this study (i.e., confrontation naming and verbal fluency).

Results were mixed with regard to measures of non-cognitive domains. Results indicated that cognitive training might have a beneficial effect on mood, a finding consistent with previous research (Brum, Forlenza, & Yassuda, 2009). This relationship may be due to a general increase in activity, increased socialization, or improved perceptions of cognitive functioning. Although previous studies have found positive changes in memory self-efficacy following participation in cognitive training (Rapp, Brenes, & Marsh, 2002), the current study did not. It is possible that using a measure of self-efficacy related to broader cognitive functioning, as opposed to memory only, would produce different results.

Limitations and Future Directions

Some limitations of this study concerned the participant sample. First, the sample used in this study was small and considerably homogenous given that all participants were well-educated Caucasian nuns. Second, the sample was quite heterogeneous with regard to the presence or lack of preexisting medical conditions and mental health status, although medication status for these conditions did not change throughout the study.

Other limitations concerned the assessment process. For example, testing occurred on two different days to prevent fatigue and these two testing sessions did not always occur at the same time of day. In addition, pre- and post-testing was not always conducted at the same time of day for each participant. Given that cognitive functioning in older adults tends to deteriorate as the day continues (Blatter & Cajochen, 2007), these variations in testing procedures could have resulted in unwanted

variability in test scores unrelated to the effects of the program.

Most importantly, because this was a pilot study designed to test the potential effects of this cognitive training program, a control group was not included. A control group would be essential to differentiate changes that occurred due to the cognitive training program from those that occur naturally as one ages. Future studies will need to incorporate no-intervention control groups as well as active control groups (e.g., book clubs) to determine if the cognitive training program is responsible for changes in cognitive functioning observed in this study.

Conclusion

The findings of the current study provide preliminary support for the use of a cognitive training program for cognitively-intact older adults. Small to large improvements were observed on most measures of cognitive functioning and small improvements in depressive symptoms were also found. These results are encouraging, particularly considering that the participants already had high levels of cognitive functioning before the program began, presumably leaving less room for improvement. The cognitive training program utilized in this study has many strengths as it targets six cognitive domains (i.e., was comprehensive), could be completed in one-hour sessions (i.e., were not overly cumbersome compared to similar cognitive training programs), were well-received by participants, and the facilitators reported liking the program. However, additional research with larger samples and appropriate control groups is needed before making more definitive conclusions about the efficacy of this cognitive training program.

Conflict of interest statement: The third author serves as a research consultant for the non-profit organization that created the cognitive training program. The researcher is not on the organization's board nor is he financially compensated for his consultation services.

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